

neither forked nor branched when they fall into one of the three families—Codonidæ, Tiariidæ, or Margelidæ. If the tentacles are branched or forked they belong to the family Cladonemidæ. These medusæ all are borne as buds upon hydroid polyps of Allman's sub-class Gymnoblæstea, sometimes called the Tubularinæ. Fifty genera of Anthomedusæ with one hundred and twenty species are described, and many are beautifully figured in the plates of Hæckel's work.

The LEPTOMEDUSÆ are characterised in addition to the points above noted by very often possessing marginal otocysts or auditory vesicles. Those which have none have eye-spots instead and belong to the families Thaumantiadæ and Cannotidæ; whilst those with otocysts usually have no eye-spots, often have more than one hundred tentacles, and belong to the families Eucopidæ and Æquoridæ. Whenever the life-history of the Leptomedusæ has been traced they have been found to be budded off from those hydriform colonies known as the Calyptoblastæ or Campanularinæ; but many have never been traced (Æquoridæ) and perhaps develop direct from the egg. Sixty-one genera and one hundred and forty species of Leptomedusæ are described by Hæckel.

Of the two Trachylina orders the TRACHOMEDUSÆ, with canal-genitals, vary according as the stomach is elongated, tubular, and devoid of a solid stalk (Petasidæ and Trachynemidæ), or short, bell-shaped, and placed on the end of a freely hanging solid stalk (Aglauridæ and Geryonidæ). Thirty-six genera and sixty species of Trachomedusæ are described and many new ones figured. It is to the genus Carmarina of this group and Cunina of the next that Hæckel seventeen years ago devoted most careful study, making known then in a most admirable monograph (*Jenaische Zeitschrift*, vols. i. and ii.) the excessively elaborate structure of these forms, far exceeding in histological differentiation and complex adaptation of structure to function anything known in the other Hydromedusæ. Here long since Hæckel had described a highly complex nervous system and sense-organs which recent investigations have confirmed and extended to other groups.

All the details of this work are fully summarised in the most systematic way in the present volume. Under the heading "Order—Trachomedusæ" we have, as in the case of each previous order, a systematic survey of the various organs, their histology, and external form; again, under each family a similar survey, narrower in scope and minuter in detail is given and finally each genus and species in turn has its special features not already included in what has been said of the family, fully exposed.

The second order of Trachylina, the Narcomedusæ, with gastral-genitalia, have, in addition to the characters noted in the paragraph above, their auditory tentaculocysts provided with otoporæ or rivets, which fix them into the jelly-like substance of the umbrella, and which are similar in origin and character to the curious peronæ by which the tentacle-roots plunged as it were into the sides of the umbrella-jelly (not therefore placed at its margin) are connected with the hard marginal ring of the umbrella. The Cunanthidæ and Peganthidæ are the families which possess otoporæ, whilst the Æginidæ and Solmaridæ, though possessing peronæ, have no

otoporæ. Twenty-three genera and seventy-five species of Narcomedusæ are described, and several figured.

We thus have no less than four hundred species of Hydromedusæ described by Prof. Hæckel, but he is careful to point out with reiterated emphasis in reference to each order, that since the Medusæ described are known in the course of their individual growth and development to alter their characters very much—such as number and position of tentacles, of radiating canals, and of sense-organs—and since at the same time it is known (just as in the vertebrate Amblystoma) that these Medusæ may and often do become sexually ripe before they have completed their changes, in fact whilst they are still very far from full growth or elaboration (pædogenesis)—it is not obvious what we are to consider a "bona species" among medusæ. What, again and again, asks Hæckel, is the criterion of a good species among Anthomedusæ, among Leptomedusæ, among Narcomedusæ, among Trachomedusæ? The inference is that there is no criterion, there are no such things as "good species." We must be content with form-species; which, in fact, is all that we, as a rule, can get at or know anything about, even in other animal groups.

It need hardly be said that this splendid book is one which every zoologist must study and enjoy.

E. RAY LANKESTER

LIGHTNING CONDUCTORS

Lightning-Conductors; their History, Nature, and Mode of Application. By Richard Anderson, F.C.S., F.G.S., M.Soc.T.E. (London: E. and F. N. Spon, 1879).

MR. ANDERSON deserves the thanks not only of the scientific world but of the public at large for the very excellent and readable volume which he has produced upon the subject of lightning-conductors. There are few persons who can lay claim to the amount of practical experience which Mr. Anderson brings to bear upon the subject, and still fewer who add to practical experience an extensive and accurate knowledge of all that has been done and written upon the subject on the Continent, in America, and in this country.

The earlier chapters of the author's work are almost purely historical; and, beginning with the days when von Guericke first produced sparks and flashes from his rude globe of sulphur, and when Hauksbee and Gray speculated on the analogies between the crackling sparks and the grander phenomena of thunder and lightning, the reader is made acquainted with the various stages of experimental discovery down to the time of Franklin. From Franklin's letters the author quotes the following memorable and characteristic extract, giving in his own words the reasons which suggested to him the experiment which rendered him famous:—

"Electrical fluid agrees with lightning in these particulars:—

- "1. Giving light.
- "2. The colour of the light.
- "3. In the crooked direction of the flame.
- "4. In the swift motion.
- "5. In being conducted by metals.
- "6. In the crack, or noise, of the explosion.
- "7. The subsisting in water, or ice.
- "8. In the rending of bodies it passes through.
- "9. In destroying animals.

"10. In melting metals.

"11. In firing inflammable substances.

"12. The sulphurous smell. The electric fluid is attracted by points, and we do not know whether this property is in lightning. But since they agree in all the particulars wherein we can already compare them, is it not probable that they agree likewise in this? Let the experiment be made."

The early experiments with lightning-rods, and their gradual spread in Europe, are detailed in the succeeding chapters, with a variety of information of various kinds extremely interesting to the general reader, and dealing with such topics as the priestly opposition to the "heretical rods," the childish jealousy of the Abbé Nollet, and the dispute whether the rods should be furnished with points or balls at their summit. Sir W. Snow Harris's labours are treated of in a chapter by themselves, and another is devoted to full descriptions of the systems of lightning-protectors adopted in the Hôtel de Ville, Brussels, and in the Houses of Parliament—both complete in their way. A chapter on weather-cocks and the methods devised for making them do duty also as lightning-conductors, gives practical information on points which we do not recollect having met with elsewhere. The concluding sections deal with Newall's system of protecting buildings, with accidents from lightning—a black catalogue—and the book ends with two suggestively practical chapters on the earth connection and on inspection of lightning-conductors. Apart from mere literary merits, these two chapters constitute the strong point of the work. At great pains Mr. Anderson points out how a good earth connection is the alpha and omega of protection from lightning. He shows how the pretentious *paratonnerres* which adorn with their immense proportions so many thousands of buildings in France, often fail for want of thorough continuity to "earth;" and, after citing case upon case, declares as the result of his experience that "probably in nine cases out of ten, whenever a building provided with a conductor is struck by lightning, it is for want of 'good earth.'" He quotes Franklin's advice drawn up for the Royal Society in 1772, on the occasion of the Government providing protection for the great powder-magazines at Purfleet, that "at each end of each magazine a well should be dug, in or through the chalk, so deep as to have in it at least four feet of standing water," in which to terminate the conductors. Mr. Anderson prominently advises the utilisation of the systems of gas and water-pipes to this end in all buildings which stand upon a dry soil.

Very strongly, but not too strongly, does the author dwell on the importance of connecting to the main conductor all large masses of metal about a house, all lead roofs and gutters, all metallic ridge-tiles and roof-ornaments, and all water-spouts. In the absence of these he would even carry conductors over all the prominent edges of buildings. The foolish system of insulating the lightning-conductor from the building by glass or porcelain holders, he unsparingly condemns. With his remarks on the importance of periodic inspection of lightning-conductors to test by galvanometer and battery the actual efficiency of the rod, and, above all, its earth connection, we cordially agree. There can be no doubt that a bad conductor is far worse than no conductor at all; and that the inmates of many "protected" houses dwell—so far as

their fancied security from lightning is concerned—in a fool's paradise.

The author describes a simple and portable form of apparatus specially adapted for testing the efficiency of lightning-conductors. It consists of three cells of a modified Leclanché battery of small internal resistance, a tangent galvanometer, and five keys for throwing at pleasure three different resistances into the circuit and comparing them with the resistance of the conductor.

While making no show of a knowledge of electrical theory, the author's language and arguments seldom clash with modern ideas as to the nature and laws of electricity. Nevertheless, in a work of this kind we should have been glad to find a little more direct reference to the scientific and theoretical aspects of the subject. We hardly think that the explanation given on p. 70 of the "return stroke" would be found adequate by one who met with the subject for the first time in these pages. The definitions of units given on p. 59 are unfortunately incorrect. The connection between the normal and abnormal electric conditions of the air is barely touched; indeed, the only reference to the subject of "atmospheric electricity" we have found in the text is to the rather antiquated views of Peltier. The researches of Sir W. Thomson, Dr. Everett, and others on this subject are not even alluded to. We regret that the author speaks somewhat disparagingly of the valuable little "note" on the protection of buildings, published a few years ago by Prof. Clerk Maxwell, and we think the author has not quite apprehended it, in the matter of the earth connection, in the sense intended by its late lamented writer.

The work contains also a list of books relating to the lightning-conductor, a list of all the important observations of accidents by lightning, and an excellent and singularly complete bibliography of the whole subject. The illustrations are numerous and good, and are free from the objectionable sensational character which writers on this and kindred topics sometimes tolerate. S. P. T.

OUR BOOK SHELF

Medicinal Plants; being Descriptions, with Original Figures, of the Principal Plants employed in Medicine, and an Account of their Properties and Uses. By Robert Bentley and Henry Trimen. 4 vols. (London: J. and A. Churchill, 1880.)

It is not often that a reviewer can rise from a critical examination of a *livre de luxe* with such an unmixed feeling of satisfaction as in the case of these handsome volumes. At the close of their four years' labours the authors have succeeded in maintaining the high standard which they set before them at the outset. We do not mean that the level is absolutely uniform throughout. Admirable as the coloured plates—nearly all of them new—are on the whole, there are some few which fail in giving a perfectly satisfactory representation of the plant depicted. The letter-press descriptions also vary, in quantity if not in quality, for which the authors account "from the varying interest taken in substances at different times, some new remedies exciting much attention, and thus demanding a full description, though not, perhaps, of great permanent value." But when we recollect that the number of species described and depicted is 306, including every medicinal plant recognised by the official pharmacopœias of Britain, India, and the United States, with a few others in addition, small inequalities of this